Space Weather Technical Forecast

Issued on Sunday, 18 February 2024 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Decreasing flare risk but with a persistent chance of isolated M-flares. S1 Solar radiation storm risk decreasing but remaining above background.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low activity with the peak flare a likely multipart C7.9 at 17/1834UTC, primarily from AR3584 but with likely some contribution from a concurrent flare from AR3576 just over the southwest limb. There are currently seven sunspots on the disc, however the main flare risk remains from the significant looping of AR3576 which remains visible over the southwest limb, despite the spot no longer being visible. This risk will continue to recede as this moves further onto the far-side in the coming hours and days. AR3583 is the most complex and developmental spot currently on the disc, with ongoing growth developing to the north of the leader spot. The other spots on the disc remain smaller and simpler, although some small growth was observed, most notably in AR3584 with the development of rudimentary penumbra.

No significant Earth-directed CMEs were observed in this period, with a faint filament eruption from the southwest disc at around 17/0219 UTC assessed as both slow and likely passing south of Earth. A slight dimming associated with the C7.9 flare from the AR3584 region remains under investigation for any resulting CME pending further imagery.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE have been at near background, at around 350 km/s, and these supported by SOHO MTOF Proton Monitor, rather than the slightly elevated speeds observed by DSCOVR. Density was below average. The Interplanetary Magnetic Field (IMF) Bt, was generally weak at 4-8nT, but did perhaps show some sign of transient activity. North-south component of the magnetic field, Bz, was also weak. It had some initially positive (northward) periods, peaking at +6nT but became generally negative (southward) from around 17/0800UTC with a minimum of -6 nT. Phi was positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0 to 2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux has been elevated above background levels but below the S1 Minor Solar Radiation Storm level and declining throughout. Electron flux (greater than 2MeV) has been at background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed fluence at 18/0000UTC was 1.21e6 pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to Low activity is forecast, with an ongoing but decreasing chance of isolated M-flares. There remains a slight chance of an X-flare into day 1 (18 Feb), primarily from AR3576 which is now over the southwest limb

Solar Wind / Geomagnetic Activity: Recent CMEs are expected to either miss or only have very minimal impact on Earth, with the most likely for an Earth-directed component being the

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filament eruption from the north-disc on 16 Feb, passing near Earth day 2-3 (late 19 Feb or early 20 Feb). No other significant solar wind enhancements feature in the period with mainly background winds expected. Geomagnetic activity is expected to be mostly Quiet through this period, perhaps becoming Unsettled with Active intervals with any CME arrival on days 2-3 (19-20 Feb).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux will continue to slowly decline towards background levels, but with a slight chance of further enhancement if any significant flares occur from either the regions on the western disk, or more likely from AR3576 just over the limb. Despite its increasingly far-side location this will continuing to bring a risk of solar radiation storms before receding further onto the far-side later in the period. High energy electron flux (greater than 2MeV) is expected to remain at background levels. The associated 24-hour electron fluence is expected to stay below the Active threshold.

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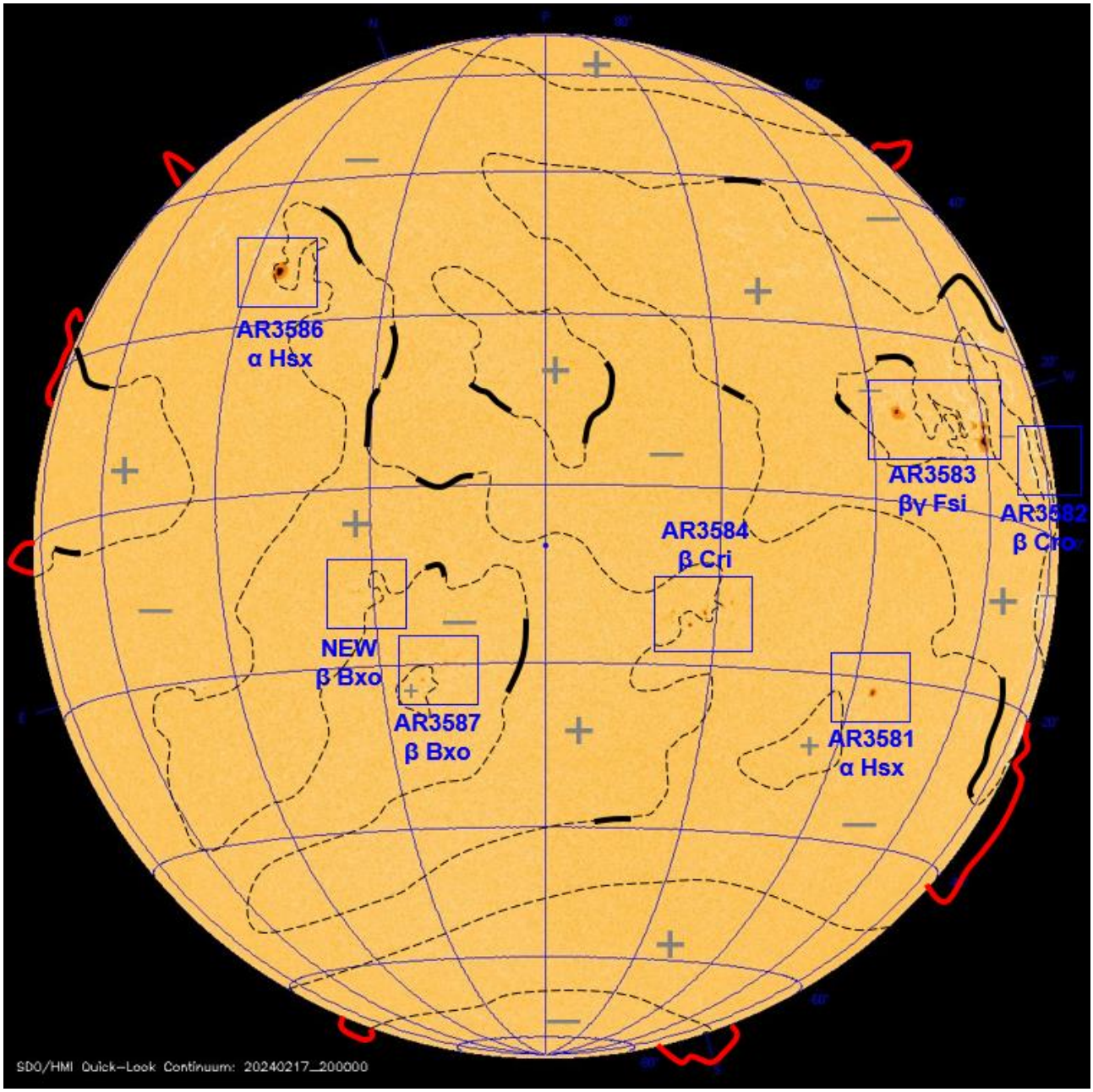
Figure 1. Solar Analysis Valid 17/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one main Earth-directed CME possible. This was a result of a filament eruption from the north centre disk on the 16 Feb. The majority of the ejecta is expected to travel north above Earth's orbit, but with the potential for some glancing influence either later day 2 (19 Feb) or early day 3 (20 Feb). The CME in association with the X2.5 flare from AR3576 is expected to pass ahead of and below Earth's orbit, although some peripheral shock enhancement is possible over similar period to the above. A very weak potential CME is under investigation associated with a flare from AR3584 later 17 Feb, pending further imagery.

No significant coronal holes are visible on the Earth-facing disc, with just a couple of very small and weak areas seen in imagery. In the absence of any significant CME arrivals, solar wind speeds are expected to remain near ambient or perhaps occasionally slightly elevated levels. Geomagnetic activity is expected to be mostly Quiet through this period, perhaps becoming Unsettled with a chance of Active intervals and a very slight chance of G1 Minor storm intervals with any CME arrival on days 2-3 (19-20 Feb), with this risk being maintained into day 4 (21 Feb) given potential CME under investigation and the ongoing CME threat from moderately large number of filaments moving into the centre-western disk.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/2232	Partial	Filament Eruption	NW	850km/s	19/2000UTC +/- 12hrs	Glancing impact most likely

Figure 2: Latest MOSWOC ENLIL Ensemble output

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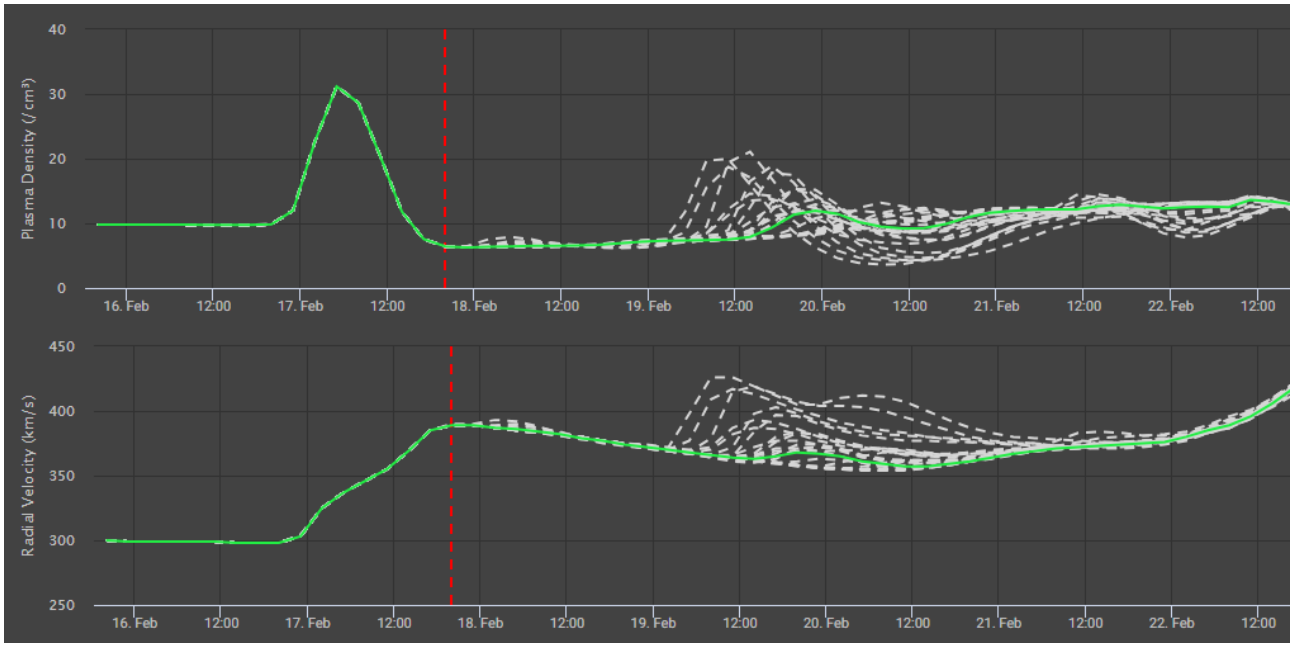

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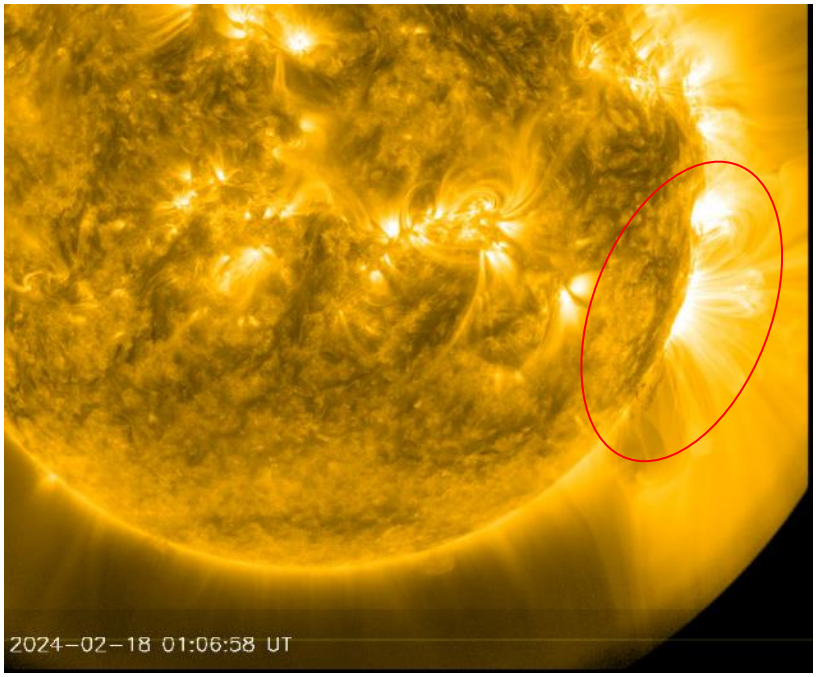
Radio Blackouts - X-Ray Flares:
Moderate to Low activity is forecast, with an ongoing chance of isolated M-flares. There remains a slight chance of an X-flare on day 1 (18 Feb), primarily from AR3576 which is now over the southwest limb, however this risk recedes day 2 (18 Feb) onward with the other regions currently on the visible disc smaller and exhibiting less complexity.

Ex-AR3576 likely remains a large, magnetically complex sunspot region, with some significant looping still visible on e.g. SDO aia-171 and 304, and any notable flares have the potential to still be visible on the Earth-facing disc, particularly during day 1 (18 Feb). Of the seven sunspot regions currently on the Earth-facing disc AR3583 is the most complex and developmental spot currently on the disc and the main source of significant flare risk, with ongoing growth developing to the north of the leader spot. Ex-AR3575 currently transiting the far side of the disk may perhaps be beginning to approach the far southeast disk by the end of the period, this spot has been the likely source of multiple large far-side CMEs over previous days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	40	40	40
Very Active	R3 to R5 X Class	No	10	5	1	5

Figure 3: Recent SDO/AIA 171 imagery, showing significant looping associated with AR3576 as it continues to rotate away around the west limb (circled).



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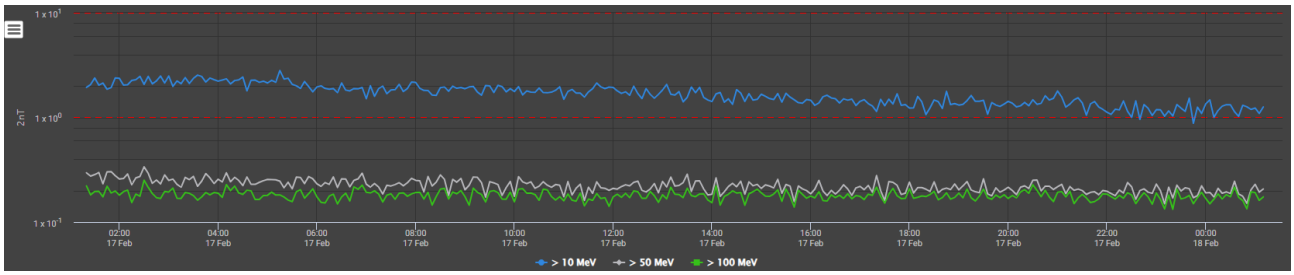
Solar Radiation Storms - (High Energy Protons):
GOES 18 high energy (greater than 10MeV) protons remain above background, but below the S1 Minor Solar Radiation Storm level. This is due to the recent enhancements from the notable flare activity on the west limb, the most recent being from the X2.5 flare of AR3576.
This region will continue to be a risk for further proton enhancements as it moves onto the far-side, with the this potential slowly receding day 2 onward (19 Feb). The current sunspots on the Earth-facing disc have a lower chance of notable flares, and are currently considered unlikely sources of further proton events, unless further development occurs.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Latest 24hr GOES18 Proton Flux trace



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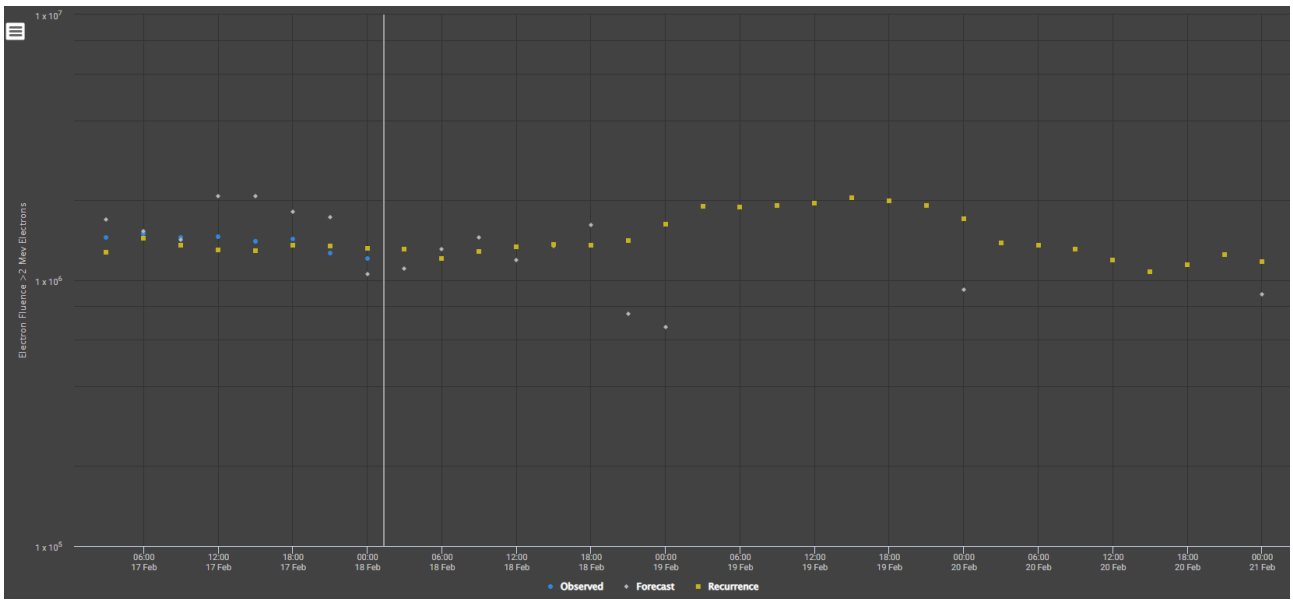
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) at GOES16 is expected to remain at background levels. There are no significant coronal hole fast wind enhancements expected, and any potential CME glancing blow on day 3 most likely to be weak. These are not expected to drive a significant increase in electron flux.
24-hour fluence values are expected to continue well below the Active (1e8 integrated pfu) threshold, as suggested by REFM which is currently expected to provide good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: Latest MOSWOC REFM model output.



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